

Guidance for 303(d) Listing Policy
Bioaccumulative Substances
Final (October 31, 2002)

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Issue Statement:

The Clean Water Act Section 303(d) list identifies surface water bodies that do not, or are not expected to, attain water quality standards. Most water quality standards are in the form of numeric criteria for constituent concentrations in water because water monitoring directly assesses whether most beneficial uses of water (e.g., drinking water supply, irrigation, stock watering, and industrial process supply) are protected. However, water monitoring often does not directly assess whether beneficial uses such as commercial and sport fishing, freshwater habitat, and wildlife habitat are protected from bioaccumulative substances. The evaluation of bioaccumulative substance concentrations in fish and other aquatic organisms more directly assesses potential impairment of these beneficial uses, but there is no State-wide guidance on how to use bioaccumulation data to define beneficial use impairment. This document has three goals: (1) describe alternate methods for listing waterbodies as impaired by bioaccumulative substances; (2) outline bioaccumulation data evaluation methods; and (3) highlight areas of both consensus and disparity.

Background:

We refer to trace metals such as mercury and lead, and trace organic compounds such as DDT, PCBs and PAHs, as bioaccumulative substances because biota typically take in these substances at a greater rate than they can eliminate them, causing the substance to accumulate in biota over their lifetimes. Repeated consumption and accumulation of bioaccumulative substances from contaminated food sources result in tissue concentrations that are higher in each

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successive level of the food chain. This process is termed biomagnification. The processes of bioaccumulation and biomagnification produce high levels of bioaccumulative contaminants in organisms high on the food chain, despite nearly immeasurable quantities of these contaminants in the water column. These contaminants strongly adsorb onto particles and thus tend to accumulate in sediments in depositional areas of freshwater, estuarine and marine water bodies. From the active layer of the sediments, these contaminants can accumulate in organisms by transfer through benthic (i.e., sediment-chironomids-fish) and water column (i.e., water-phytoplankton-zooplankton-fish) pathways.

In many cases, water bodies appear to meet numerical water quality objectives for bioaccumulative substances when we rely solely upon water column monitoring data. However, sediment chemistry data or tissue bioaccumulation data may provide evidence of elevated concentrations of these contaminants at levels that cause water quality impairments.

Bioaccumulation can pose a human health risk through consumption of fish or shellfish with elevated tissue concentrations of contaminants, particularly carcinogens. Bioaccumulation also can pose an ecological risk through impacts to aquatic organisms (e.g., impaired growth or reproduction) due to elevated body burdens of contaminants and through impacts to higher trophic level predators due to bioaccumulation or bioconcentration of contaminants (e.g., egg-shell thinning in bald eagles).

Bioaccumulation substances concentration data are collected by statewide monitoring programs such as the State Mussel Watch Program (MWP), Toxic Substances Monitoring Program (TSM), and Contaminated Seafood Consumption Program, as well as by NPDES discharger self-monitoring programs (especially for major dischargers) and special studies. Fish samples may be analyzed from livers, muscle fillets or whole body samples. Large individuals may be analyzed separately, or several individuals of the same species may be composited into a single sample for analysis. Invertebrates such as clams or mussels may be analyzed from whole body samples, typically as composites of several individuals. However, larger invertebrates, such as crabs, may be analyzed from hepatopancreas or muscle samples, either for each individual or for composites of several individuals.

Sediment chemistry data has been collected by the Bay Protection and Toxic Cleanup Program, which ended in 1998, and occasionally has been collected as part of the SMV and TSM Programs. Sediment chemistry data may be collected during sediment characterization studies for proposed dredging projects or to evaluate sites for cleanup or remediation activities. Sediment chemistry data also may be collected as part of NPDES discharger self-monitoring programs (especially for major dischargers) or special studies. Sediment samples often are analyzed for surficial sediments (top 2 centimeters) or for cores to various depths (which may be subsampled for different regions, such as surface to 3 feet deep, 3 to 6 feet deep, etc.). For dredging characterization studies, several sediment samples collected over a wide area

often are composited into a single sample for analysis.

Criteria for Listing Waterbodies as Impaired:

A waterbody may be listed as impaired if any one of the following three criteria is met:

- 1) The water body has been posted with a fish or shellfish consumption advisory (we recommend relying upon advisories issued by the Office of Environmental Health Hazard Assessment or those issued by a local health agency based on risk assessment s). Impairment would pertain to beneficial uses related to human consumption, including, but not limited to, Commercial and Sport Fishing (COMM) or Shellfish Harvesting (SHELL).
- 2) Contaminant concentrations measured in aquatic organisms exceed appropriate standards for protection of human health (we recommend relying upon screening values developed by the Office of Environmental Health Hazard Assessment and the United States Environmental Protection Agency, listed in Table 1 below). Impairment would pertain to beneficial uses related to human consumption, including, but not limited to, Commercial and Sport Fishing (COMM) or Shellfish Harvesting (SHELL).
- 3) Contaminant concentrations measured in aquatic organisms exceed appropriate standards for protection of wildlife (we recommend relying upon screening values developed by the National Academy of Sciences and the United States Fish and Wildlife Service, listed in Table 2 below). Impairment would pertain to beneficial uses related to maintenance of aquatic habitat or healthy aquatic communities, including, but not limited to, Warm Freshwater Habitat (WARM), Cold Freshwater Habitat (COLD), Inland Saline Water Habitat (SAL), Estuarine Habitat (EST), Wetland Habitat (WET), Marine Habitat (MAR) or Wildlife Habitat (WILD).

Table 1. Human Health Protection Criteria for Evaluation of Bioaccumulation Monitoring Data.

Contaminant	OEHHA Screening Values ¹	USEPA Screening Values ²
Arsenic	1.0 ppm	
Cadmium	3.0 ppm	
Mercury	0.3 ppm	
Selenium	2.0 ppm	
Tributyltin		1.2 ppm
Total DDT	100 ppb	
Total PCBs	20 ppb	
Total PAHs		5.47 ppb
Chlordane (total)	30 ppb	
Dieldrin	2.0 ppb	
Endosulfan (total)	20,000 ppb	
Endrin	1,000 ppb	
Lindane (gamma hexachloro-cyclohexane)	30 ppb	
Heptachlor epoxide	4.0 ppb	
Hexachlorobenzene	20 ppb	
Mirex		800 ppb
Toxaphene	30 ppb	
Diazinon	300 ppb	
Chlorpyrifos	10,000 ppb	
Disulfoton	100 ppb	
Terbufos		80 ppb
Oxyfluorfen		546 ppb
Ethion	2,000 ppb	
Dioxin (TEQ)	0.3 ppt	

¹Brodberg, B. and G. Pollock, 1999, Prevalence of selected target chemical contaminants in sport fish from two California lakes: public health designed screening study, CalEPA, OEHHA, EPA Assistance Agreement No. CX 825856-01-0.

²U.S. EPA, 2000, Guidance for assessing contaminant data for use in advisories, Volume 1, Fish sampling and analysis, Third Edition, EPA 823-B-00-007.

Table 2. Wildlife Protection Criteria for Evaluation of Bioaccumulation Monitoring Data.

Contaminant	NAS Guidelines ¹	USFWS Guidelines ²
Arsenic		0.25 ppm
Copper		15 ppm
Mercury		0.3 ppm
Aldrin	100 ppb	
Total DDT	1,000 ppb	
Total PCBs	500 ppb	
Chlordane (total)	100 ppb	
Dieldrin	100 ppb	
Endosulfan (total)	100 ppb	
Endrin	100 ppb	
Lindane (gamma hexachloro-cyclohexane)	100 ppb	
Hexachlorocyclohexane (total)	100 ppb	
Heptachlor	100 ppb	
Heptachlor epoxide	100 ppb	
Toxaphene	100 ppb	

¹National Academy of Sciences-National Academy of Engineering. 1973. Water Quality Criteria 1972 (Blue Book). EPA Ecological Research Series. EPA-R3-73-033. U.S. Environmental Protection Agency, Washington, D.C.

Interpretation of Listing Criteria

1) Advisories

Office of Environmental Health Hazard Assessment advisories would be the primary criterion for listing, since these actions are based upon risk assessments, but local agency advisories can be relied upon if they are based upon similar methodologies. In some cases, it may not be appropriate to list a water body as impaired even though an advisory has been issued (for example, where an advisory covers a large geographic region, but the sampling data were limited to certain water bodies or where an advisory pertains to migratory or highly mobile species). Also, a water body need not be listed as impaired if more recent data or information indicate that designated beneficial uses are being attained and the advisory no longer is representative of current conditions (for example, following implementation of a Total Maximum Daily Load or other management actions).

2) Screening Values for Protection of Human Health

Listing would be based upon tissue contaminant concentrations that exceed the Office of Health Hazard Assessment and United States Environmental Protection Agency Screening Values listed in Table 1. These values apply to muscle tissue (e.g., fillets) or edible flesh (e.g., whole mussels or clams) samples collected in all types of waters (marine, estuarine, fresh). A water body may be deemed as impaired if the median value (50th percentile) of the bioaccumulation data set exceeds the screening for a particular contaminant. We recommend using recent monitoring data (for example, collected within the 5 years preceding the assessment) and relying upon a minimum of 3 analyzed samples that represent at least 9 organisms (for example, 3 composites made up of 3 individual organisms each or 9 individuals).

Regional Board staff may choose to evaluate older monitoring data or rely upon fewer samples if circumstances warrant. Regional Board staff also may wish to review the assumptions used to develop the OEHHA and EPA screening values and choose to use different consumption rates or other factors based upon site-specific conditions to assess impairments. Regional Board staff may choose to use a weighted average rather than the median value for determinations of exceedance of the screening values, if appropriate. Regional Board staff should endeavor to collect monitoring data for organisms that are representative of the water body conditions and the beneficial use under consideration.

We do not recommend basing listing decisions upon exceedances of Maximum Tissue Residue Levels, since these values do not incorporate human consumption rates or risk assessment methodologies. We do not recommend basing listing

decisions upon exceedances of Median International Standards, since these were based on a limited 1982 survey conducted by the Food and Agriculture Organization of the United Nations and the results never have been updated. We do not recommend basing listing decisions upon exceedances of Food and Drug Administration Action Levels, since these are based on dated information and were not developed with risk assessment methodology. We do not recommend basing listing decisions upon exceedances of Elevated Data Levels, since these are based on a statistical ranking of a particular database and are not necessarily related to adverse impacts or beneficial use impairments.

3) Screening Values for Protection of Wildlife

Listing would be based upon tissue contaminant concentrations that exceed the National Academy of Sciences and United States Fish and Wildlife Guidelines listed in Table 2. These values apply to whole body samples collected in all types of waters (marine, estuarine, fresh). A water body may be deemed as impaired if the median value (50th percentile) of the bioaccumulation data set exceeds the screening for a particular contaminant. We recommend using recent monitoring data (for example, collected within the 5 years preceding the assessment) and relying upon a minimum of 3 analyzed samples that represent at least 9 organisms (for example, 3 composites made up of 3 individual organisms each or 9 individuals).

Regional Board staff may choose to evaluate older monitoring data or rely upon fewer samples if circumstances warrant. Regional Board staff may choose to use a weighted average rather than the median value for determinations of exceedance of the screening values, if appropriate. Regional Board staff should endeavor to collect monitoring data for organisms that are representative of the water body conditions and the beneficial use under consideration.

We recognize that the National Academy of Sciences Guidelines are rather dated (1973) and are too high to be totally protective for wildlife. We also recognize that the United States Fish and Wildlife Guidelines only cover a limited number of contaminants (three metals). Therefore, our working group recommends that the State initiate an effort to develop wildlife protection criteria for use in California for evaluation of bioaccumulation data. This effort should include a review of wildlife protection values developed in other areas, such as guidelines proposed by Environment Canada and the Great Lakes Initiative, and their applicability to California water bodies.

From: Karen Taberski
To: Patricia Gouveia
Date: 6/26/03 11:24:43 AM
Subject: 303d Guidance for bioaccumulation/ health advisories and tissue screening values

Hi Patti,

I have attached the recommendation for listing from the Regional Board Bioaccumulation Workgroup and a complete listing of tissue guidelines. We have recommended using OEHHA values, since they are risk based and specific to California. We have recommended using EPA screening values when an OEHHA value doesn't exist for a particular chemical. OEHHA screening values are recent (1999), risk based and have been adjusted (particularly for selenium) based on background levels. EPA values are also recent (2002) and risk based. Both have gone through technical review and agency "regulatory" review. They are both based on IRIS values. From a technical perspective risk based values have much more scientific validity than calculated or modeled values like MTRs.

In the workgroup we did not recommend connecting tissue concentrations to water or sediment concentrations. EPA guidance doesn't recommend it and I only think it makes sense in the case of large waterbodies with migratory fish. However, when striped bass had a health advisory for mercury, we listed the Bay and Delta where there are potential sources.

We didn't consider the range of OEHHA advisories in the workgroup and I didn't really think of this until I was talking to Margie Gassel at OEHHA (fish group) several weeks ago. It seems that this should be considered. Since advisories range from no consumption to no more than 3 meals per week, what constitutes impairment? My opinion is that anything less than 1 meal per week should probably be an impairment, but this is a policy decision. Call me if you have any questions. Karen

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Potential Guidelines for Bioaccumulation Assessment

(-----Human Consumption Criteria-----) {---Aquatic Life Protection---}

Constituent	OEHHA	USEPA	MTRL			MIS	FDA	NAS	Env. Canada
	All waters	All waters	Inland	Bay/estuary	Ocean	Freshwater Fish/Marine Shellfish	Freshwater Fish/Marine Fish	Freshwater Fish	All waters
Arsenic	1.0 ppm	0.026 ppm (inorganic)				1.5/1.4 ppm			
Cadmium	3.0 ppm	4.0 ppm				0.3/1.0 ppm			
Chromium						1.0/1.0 ppm			
Copper						20.0/20.0 ppm			
Lead						2.0/2.0 ppm			
Mercury	0.3 ppm	0.3 ppm				0.5/0.5 ppm	1.0/1.0 ppm	0.5 ppm (as methyl-mercury)	
Nickel			28.7 ppm	220 ppm					
Selenium	2.0 ppm	20 ppm				2.0/0.3 ppm			
Tributyltin		1.2 ppm							
Zinc						45.0/70.0 ppm			
Aldrin			0.05 ppb	0.33 ppb	0.1 ppb		300/300 ppb	100 ppb	
P,p'-DDD			44.5 ppb	44.5 ppb					
P,p'-DDE			32.0 ppb	32.0 ppb					
P,p'-DDT			32.0 ppb	32.0 ppb	9.1 ppb				
Total DDT	100 ppb	117 ppb					5000/5000 ppb	1000 ppb	14 ppb
Dicofol		1600 ppb							
Dieldrin	2.0 ppb	2.5 ppb	0.65 ppb	0.7 ppb	0.2 ppb		300/300 ppb	100 ppb	
Endosulfan I			29700 ppb	64800 ppb					
Endosulfan II			29700 ppb	64800 ppb					
Endosulfan sulfate			29700 ppb	64800 ppb					

Endosulfan	20000 ppb (total)	24000 ppb (I and II)						100 ppb (total)	
Constituent	OEHHA	USEPA	MTRL			MIS	FDA	NAS	Env. Canada
	All waters	All waters	Inland	Bay/estuary	Ocean	Freshwater Fish/Marine Shellfish	Freshwater Fish/Marine Fish	Freshwater Fish	All waters
Endrin	1000 ppb	1200 ppb	3020 ppb	3020 ppb			300/300 ppm	100 ppb	
Hexachloro-cyclohexane, alpha			0.5 ppb	1.7 ppb					
Hexachloro-cyclohexane, beta			1.8 ppb	6.0 ppb					
Hexachloro-cyclohexane, gamma (lindane)	30 ppb	30.7 ppb	2.5 ppb	8.2 ppb				100 ppb	
Hexachloro-cyclohexane (total)	30 ppb							100 ppb	
Heptachlor			2.4 ppb	2.3 ppb	8.1 ppb		300/300 ppb	100 ppb	
Heptachlor epoxide	4.0 ppb	4.39 ppb	1.1 ppb	1.2 ppb			300/300 ppb	100 ppb	
Hexachloro-benzene	20 ppb	25 ppb	6.5 ppb	6.7 ppb	2.0 ppb				
Mirex		800 ppb							
Toxaphene	30 ppb	36.3 ppb	9.6 ppb	9.8 ppb	2.75 ppb		5000/5000 ppb	100 ppb	
Diazinon	300 ppb	2800 ppb							
Chlorpyrifos	10000 ppb	1200 ppb							
Disulfoton	100 ppb	160 ppb							
Terbufos		80 ppb							
Oxyfluorfen		546 ppb							
Ethion	2000 ppb	2000 ppb							

Total Chlordane	30 ppb	114 ppb	8.0 ppb	8.3 ppb	0.32 ppb			100 ppb	
Lindane	30 ppb	30.7 ppb							
Constituent	OEHHA	USEPA	MTRL			MIS	FDA	NAS	Env. Canada
	All waters	All waters	Inland	Bay/estuary	Ocean	Freshwater Fish/Marine Shellfish	Freshwater Fish/Marine Fish	Freshwater Fish	All waters
PCBs (total)	20 ppb	20 ppb	5.3 ppb	5.3 ppb	0.6 ppb		2000/2000 ppb	500 ppb	0.79 ppb
Dioxin (TEQ)	0.3 ppt	2.56x10 ⁻⁴ ppb (TCDD) change to 0.256 ppt							
PAHs (total)		5.47 ppb							
Chem A								100 ppb	

OEHHA = Office of Environmental Health Hazard Assessment - 1999 screening values

USEPA = United States Environmental Protection Agency - 2000 screening values

MTRL = Maximum Tissue Residue Level - derived from California Toxics Rule and Ocean Plan objectives

MIS = Median International Standards - 1982 survey of member nations by Food and Drug Organization of United Nations

FDA = Food and Drug Administration - 1985 list of maximum concentration levels for toxic substances in human foods

NAS = National Academy of Sciences - 1973 list of maximum concentrations of toxic substances in fish to protect the species and predators

Env. Canada = Environmental Canada - 1998 list of maximum concentrations of toxic substances in fish to protect predators

Chemical group A = refers to the combination of aldrin + dieldrin + endrin + heptachlor + heptachlor epoxide + chlordane (total) + lindane + hyxachlorocyclohexane (total) + endosulfan (total) + toxaphene

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